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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/677,478	10/02/2000	Guy T. Blalock	M122-1544	4522

21567 7590 09/16/2005
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EXAMINER

VINH, LAN

ART UNIT PAPER NUMBER

1765

DATE MAILED: 09/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/677,478

Applicant(s)

BLALOCK ET AL.

Examiner

Lan Vinh

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 July 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3, 6, 7, 10-13, 16-19, 21-28, 30, 32, 33, 36-42, 44, 46-48, 50 and 53-93 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 21-28, 30, 32, 33, 36-42, 44, 46, 58-61, 69-74, 82, 83, 89 and 90 is/are allowed.
- 6) ☒ Claim(s) 1-3, 6, 7, 10-13, 16-19, 47, 48, 50, 53-57, 80, 81, 84-88 and 91-93 is/are rejected.
- 7) ☒ Claim(s) 62-68 and 75-79 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 47, 53, 54-57, 84-85, 91-92 are rejected under 35 U.S.C. 102(e) as being anticipated by Ding et al (US 5,814, 563)

Ding discloses a method for etching dielectric. The method comprises the steps of:
positioning a semiconductor wafer on an electrostatic chuck within an inductively coupled plasma etch chamber (col 4, lines 51-56), the semiconductor wafer having a photoresist layer formed on an insulative oxide layer, the photoresist layer having contact opening pattern formed therethrough (col 4, lines 13-20; fig. 1b)

first plasma etching contact openings within the insulative oxide on the semiconductor wafer through the contact opening pattern formed in the photoresist layer with a gas comprising carbon and fluorine, a polymer comprising carbon and fluorine forming over at least some internal surface of the plasma etch chamber during the first plasma etching (col 4, lines 15-25; col 6, lines 1-5; col 9, lines 4-6)

after the first plasma etching and with the wafer on the electrostatic chuck,

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providing the electrostatic chuck at ground potential while second plasma etching at subatmospheric pressure using a gas comprising a CO gas/ oxygen component and CHF₃ and NH₃ effective to etch photoresist from the wafer and polymer from chamber internal surfaces, and forming HF during the second plasma etching from fluorine liberated from the polymer (col 10, lines 1-56; fig. 2). Fig. 1d of Ding shows layer 48 restricts widening of the contact opening 45 formed in the insulative oxide resulting from further etching of the material on the semiconductor wafer during the second plasma etching

The limitations of claims 53-54, 84-85 have been discussed above

Regarding claims 56-57, Ding discloses forming volatile COF₂ (col 9, lines 5-7)

Regarding claims 91-92, Ding discloses using different etch chemistries (col 6, lines 1-10)

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-3, 6-7, 80, 87 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ding et al (US 5,814,563) in view of Sahin et al (US 6,465,051)

Ding discloses a method for etching dielectric. The method comprises the steps of:

first plasma etching contact openings in a wafer having a photoresist layer formed thereon with a gas comprising carbon and fluorine, a polymer comprising carbon and fluorine forming over at least some internal surface of the plasma etch chamber during the first plasma etching (col 4, lines 15-25; col 6, lines 1-5; col 9, lines 4-6)

after forming the polymer plasma etching using NH_3 / a gas effective to etch photoresist from the wafer and polymer from chamber internal surfaces and forming HF /hydrogen halide during the second plasma etching from fluorine liberated from the polymer (col 10, lines 1-56; fig. 2). Ding also discloses using a ratio of 0.1:1 of oxygen-containing gas and hydrogen component (col 9, lines 23-25)

Unlike the instant claimed inventions as per claims 1, 7, Ding fails to disclose using oxygen gas (1000 sccm) in the plasma etching step

Sahin discloses a method for operating plasma reactor comprises the step of plasma etching using hydrogen, fluorocarbon and oxygen (0.5 to 3 liter per/min flow rate) (col 7, lines 18-21)

Thus, one skilled in the art at the time the invention was made would have found it obvious to modify Ding's second plasma etching step by plasma etching using hydrogen, fluorocarbon and oxygen to perform a chamber clean operation and to remove absorbed fluorine atoms from the chamber interior as taught by Sahin (col 7, lines 16-21, lines 50-52))

The limitations of claims 2-3, 80 has been discussed above

Regarding claim 87, Ding discloses using different etch chemistries (col 6, lines 1-10)

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5. Claims 10-13, 16-19, 81, 88 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ding et al (US 5,814,563) in view of Sahin et al (US 6,465,051)

Ding discloses a method for etching dielectric. The method comprises the steps of: first plasma etching contact openings in a wafer with a gas comprising carbon and fluorine, a polymer comprising carbon and fluorine forming over at least some internal surface of the plasma etch chamber during the first plasma etching (col 4, lines 15-25; col 6, lines 1-5; col 9, lines 4-6)

after the first plasma etching, second plasma etching at subatmospheric pressure using a gas of CHF₃/hydrocarbon compound effective to etch to etch the polymer from chamber internal surfaces and forming HF/hydrogen halide during the second plasma etching from fluorine liberated from the polymer (col 10, lines 1-56; fig. 2). Ding also discloses using 5 sccm/5% of CHF₃/carbon compound in the mixture (col 10, lines 24-25)

Unlike the instant claimed inventions as per claim 10, Ding fails to disclose using oxygen gas in the plasma etching step

Sahin discloses a method for operating plasma reactor comprises the step of second plasma etching using fluorocarbon and oxygen (col 7, lines 18-21)

Thus, one skilled in the art at the time the invention was made would have found it obvious to modify Ding's second plasma etching step by plasma etching using fluorocarbon and oxygen to perform a chamber clean operation as taught by Sahin (col 7, lines 16-21, lines 50-52))

The limitations of claims 11, 19 have been discussed above

Regarding claim 81, Ding disclose forming a silicon oxide layer on the wafer (col 3, lines 54-55)

Regarding claims 16-17, Ding discloses forming volatile COF₂ (col 9, lines 5-7)

Regarding claim 18, Ding discloses flowing CO₂ into the chamber (col 9, lines 1-3)

Regarding claim 88, Ding discloses using different etch chemistries (col 6, lines 1-10)

6. Claims 48, 50, 86, 93 rejected under 35 U.S.C. 103(a) as being unpatentable over Ding et al (US 5,814,563) in view of Sahin et al (US 6,465,051)

Ding discloses a method for etching dielectric. The method comprises the steps of: positioning a semiconductor wafer on an electrostatic chuck within an inductively coupled plasma etch chamber (col 4, lines 51-56), the semiconductor wafer having a photoresist layer formed on an insulative oxide layer, the photoresist layer having contact opening pattern formed therethrough (col 4, lines 13-20; fig. 1b)

first plasma etching contact openings within the insulative oxide on the semiconductor wafer through the contact opening pattern formed in the photoresist layer with a gas comprising carbon and fluorine, a polymer comprising carbon and fluorine forming over at least some internal surface of the plasma etch chamber during the first plasma etching (col 4, lines 15-25; col 6, lines 1-5; col 9, lines 4-6)

after the first plasma etching and with the wafer on the electrostatic chuck, second plasma etching at subatmospheric pressure using a gas comprising CHF₃/carbon component and NH₃ (50 sccm) effective to etch photoresist from the wafer and polymer from chamber internal surfaces, and forming HF during the second plasma etching from

fluorine liberated from the polymer (col 10, lines 1-56; fig. 2). Fig. 1d of Ding shows layer 48 restricts widening of the contact opening 45 formed in the insulative oxide resulting from further etching of the material on the semiconductor wafer during the second plasma etching

Unlike the instant claimed inventions as per claims 48, 50, Ding fails to disclose using oxygen gas (1000 sccm) and hydrogen gas in the second plasma etching step

Sahin discloses a method for operating plasma reactor comprises the step of second plasma etching using hydrogen, fluorocarbon and oxygen (0.5 to 3 liter per/min flow rate) (col 7, lines 18-21)

Thus, one skilled in the art at the time the invention was made would have found it obvious to modify Ding's second plasma etching step by plasma etching using hydrogen, fluorocarbon and oxygen to perform a chamber clean operation and to remove absorbed fluorine atoms from the chamber interior as taught by Sahin (col 7, lines 16-21, lines 50-52))

The limitations of claim 86 has been discussed above

Regarding claim 93, Ding discloses using different etch chemistries (col 6, lines 1-10)

Allowable Subject Matter

7. Claims 21-28, 30, 32-33, 36-42, 44, 46, 58, 59-61, 69-74, 82, 83, 89, 90 allowed.

Claims 62, 63-68, 75-79 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

8. Applicant's arguments filed 7/5/2005 with respect to the rejection(s) of claims 1-3, 6,7, 10-13, 16-19, 21-28, 30, 32, 33, 36-42, 44, 46-48, 50, 53-57, 80, 81, 84-88, 91-93 have been fully considered but they are not persuasive.

Applicant's argument with respect to the rejection(s) of claims 59, 62 under 35 U.S.C 103(a) have been fully considered and are persuasive. The rejection(s) has been withdrawn.

Applicant argue that there is no suggestion to combine the references of Ding and Sahin because Ding is void of any evidence that concerns with problem regarding cleaning or removal of fluorine atoms to provide the necessary motivation to look into Sahin for meaningful teaching. This argument is unpersuasive because as recited in col 10, lines 5-10 of Ding, Ding discloses that "hydrogen species that combine with free fluorine radicals to form gaseous HF that is exhausted from the chamber". Thus, the examiner asserts that Ding is concerned with problem regarding cleaning or removal of fluorine atoms from the chamber. One skilled in the art at the time the invention was made would have found it obvious to employ Sahin teaching to clean the process chamber of Ding because Sahin discloses that his method removes absorbed fluorine from the chamber interior (col 7, lines 49-55)

Applicants argue that Ding is void of disclosing or suggest the claimed polymer comprising carbon and halogen over at least some internal surface of the plasma chamber. This argument is unpersuasive because as taught at col 9, lines 4-6 of Ding, Ding discloses forming COF₂/a composition of carbon and halogen in the process

chamber. The examiner asserts that Ding teaching reads on the claimed polymer comprising carbon and halogen over at least some internal surface of the chamber

Applicants argue that Ding completely devoid of teaching directed to processing the polymer after it is formed. This argument is unpersuasive because as recited in col 9, lines 45-50 of Ding, Ding discloses the step of sputtering of the passivating deposit 46/polymer to reduce the thickness of the deposit 46. Hence, it is asserted that Ding teaching is directed to processing the polymer after it is formed

It is argued that Ding fails to teach a gas having a hydrogen component effective to form a gaseous hydrogen halide from halogen liberated from the polymer. However, as recited in col 10, lines 5-10 of Ding, Ding discloses using the fluorohydrocarbon gas provides hydrogen species that combine with fluorine to form HF, which reads on a gas having a hydrogen component effective to form a gaseous hydrogen halide from halogen liberated from the polymer

Applicants argue that Sahin does not teach or suggest the carbon compound is provided at from about 5% to about 80% by volume of the oxygen and carbon compound mixture because Sahin teaches a volumetric flow ratio of carbon, fluorine and oxygen but not carbon alone in a ratio relative to the oxygen component. This argument is unpersuasive because it does not commensurate with the scope of claim 10 since claim 10 does not require/recite "carbon alone in a ratio relative to the oxygen component". Since Sahin discloses a volumetric flow ratio of fluorocarbon and oxygen, Sahin teaching reads on a volumetric flow ratio of carbon compound and oxygen as required in claim 10.

9. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to be 'LV' followed by a stylized flourish.

LV

September 14, 2005